

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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PCT

WRITTEN OPINION OF THE
INTERNATIONAL PRELIMINARY
EXAMINING AUTHORITY

(PCT Rule 66)

Applicant's or agent's file reference P 20146 PC 00		Date of mailing (day/month/year)	23 -04- 2004
International application No. PCT/NO 2003/000169	International filing date (day/month/year) 23.05.2003	Priority date (day/month/year) 11.06.2002	
International Patent Classification (IPC) or both national classification and IPC B04C 3/06, B01D 45/12, B04C 3/00, F22B 37/32			
Applicant Flow Dynamics AS et al			

- ☐ The written opinion established by the International Searching Authority:
☐ is ☐ is not
 considered to be a written opinion of the International Preliminary Examining Authority.
- This first (first, etc.) opinion contains indications relating to the following items:
 - ☒ Box No. I Basis of the opinion
 - ☐ Box No. II Priority
 - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - ☐ Box No. IV Lack of unity of invention
 - ☒ Box No. V Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - ☐ Box No. VI Certain documents cited
 - ☐ Box No. VII Certain defects in the international application
 - ☐ Box No. VIII Certain observations on the international application
- The applicant is hereby invited to reply to this opinion.

When? See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(e).

How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

Also For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4bis. For an informal communication with the examiner, see Rule 66.6. For an additional opportunity to submit amendments, see Rule 66.4.

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.
- The final date by which the international preliminary report on patentability (Chapter II of the PCT) must be established according to Rule 69.2 is: 11.10.2004

Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 46 8 667 72 88	Authorized officer Fredrik Andersson/ELY Telephone No. 46 8 782 25 00
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**WRITTEN OPINION OF THE
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY**

International application No.

PCT/NO 2003/000169

Box No. I Basis of the opinion

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☒ This opinion is based on a translation from the original language into the following language English, which is the language of a translation furnished for the purposes of:

- ☐ international search (under Rules 12.3 and 23.1(b))
☒ publication of the international application (under Rule 12.4)
☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the elements of the international application, this opinion has been established on the basis of *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed.")*:

☒ the international application as originally filed/furnished

☐ the description:

pages _____ as originally filed/furnished

pages _____ received by this Authority on _____

pages _____ received by this Authority on _____

☐ the claims:

pages _____ as originally filed/furnished

pages _____ as amended (together with any statement) under Article 19

pages _____ received by this Authority on _____

pages _____ received by this Authority on _____

☐ the drawings:

pages _____ as originally filed/furnished

pages _____ received by this Authority on _____

pages _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheets/figs _____

☐ the sequence listing (*specify*): _____

☐ any table(s) related to the sequence listing (*specify*): _____

4. ☐ This opinion has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheets/figs _____

☐ the sequence listing (*specify*): _____

☐ any table(s) related to the sequence listing (*specify*): _____

**WRITTEN OPINION OF THE
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY**

International application No.

PCT/NO 2003/000169

Box No. V Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>3, 4</u>
	Claims	<u>1, 2</u>
Inventive step (IS)	Claims	<u>3</u>
	Claims	<u>1, 2, 4</u>
Industrial applicability (IA)	Claims	<u>1-4</u>
	Claims	<u></u>

2. Citations and explanations:

Documents cited in the International Search Report which are of particular relevance:

D1: GB 1127514 A
D2: EP 0203896 A2

From D1, (see figure 1 and page 2, line 40-100) an axial cyclone separator according to claim 1 is known. The cyclone in D1 comprises an inlet pipe (at the top of figure 1), a transition part (2) and a downstream pipe (1). A rotational element (3) is located in the transitional part (2). The cross-sectional area of the downstream pipe is smaller than the cross-sectional area of the inlet pipe.

Note that the cyclone in D1 is used for separating particles from a gas, which in fact is considered to be the same as separating fluid from a gas, as is the case according to the invention. Even if the applicant is of another opinion, the apparatus in D1 would work just as well for separating fluid from a gas, without the necessity of changing the apparatus in D1 (see PCT Search Guidelines of 1998 chapter III-3.17 and Examination Guidelines of 1998 chapter III-4.8 corresponding to Guideline 5.23 of 2004)

Therefore, the invention according to claims 1 and 2 lacks novelty with regard to D1.

.../...

WRITTEN OPINION OF THE
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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V


The word "insignificant" in claim 4 is somewhat unclear. The skilled person is required to interpret what is meant by "the cross-sectional area of the rotational element (10) in the flow direction is insignificant as compared with the flow area of the axial cyclone". How much is insignificant? Also in D1 the cross-sectional area of the rotational element is much smaller compared to the cross-sectional area of the axial cyclone. And even if "insignificant" is specified more clearly, the difference between the invention according to claim 4 and D1 is not considered to involve an inventive step, with regard to D1.

See also D2, which concerns an axial cyclone for separating fluid from a gas. The cyclone in D2 also comprises the features of claims 1 and 2. For claim 2 of the invention see especially figure 2 in D2, where it is clear that the rotational element is partly located in the transitional part. For claim 4 see the discussion above.


Thus, the invention according to claims 1 and 2 lacks novelty also with regard to D2, and the invention according to claim 4 is not considered to involve an inventive step also with regard to D2.

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D113 Rec'd PCT/PTO 01 DEC 2004



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REGISTERED

By telefax 3 pages

Our Ref: P20146PC00 js

Date: June 7, 2004

International PCT Application No. PCT/NO03/00169
Flow Dynamics AS

We refer to the written opinion of April 23, 2004 in which the GB patent 1127514 and the EP patent application 0203896, below denoted respectively D1 and D2, are cited as particularly relevant.

D1 teach a cyclone that represents fundamentally different fluid flow behaviour compared to the cyclone of the present invention. The swirl element (rotation element) is based on a core cylinder representing a massive obstruction for the flow through the cyclone. For that reason, a significantly increased pressure drop will result with the design of D1, as compared to the present invention. This obstruction is also the reason for why this cyclone only will function for solid particles and not liquid droplets, as opposed to the opinion of the examiner. In a cyclone according to D1 the liquid will attach to the core cylinder of the swirl element. At this position, at the wall of the core of the swirl cylinder, the rotational velocity is zero. The direct impact on the performance of this cyclone for liquid droplet separation is therefore the well know creep problem. That is, liquid will tend to creep on the core cylinder of the swirl element, and leave the swirl element in a "dead" zone of the flow just after the swirl element, and for that reason, not be separated. The effect is known as the creep problem for cyclones in gas-liquid separation applications. Furthermore, the shear force acting on this liquid film, creeping on the core of the swirl element, will in condensate operation (typical oil production systems) where the surface tension is low, generate a massive liquid entrainment. Liquid entrainment in cyclones has a strong detrimental effect on the performance. Thus the droplets entrained into the gas phase normally enter the gas phase as significantly smaller droplets compared to the droplet size at the inlet of the cyclone.

These two problems, namely the creep problem and the increased pressure drop due to obstruction of the flow are basically solved by the present invention. The invention thus represents a significant improvement in the field of liquid droplet separation from gases. The core of the swirl element is for the new cyclone insignificant with respect to flow obstruction, basically less than 20% of the flow area, see the description p 3, 1 17-18. As such, the invention is of a straight through type, and the only pressure drop imposed the flow is due to the swirl of the flow.

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Another major difference between D1 and the present invention is that D1 accepts a slip flow between the outer section of the swirl blades and the cyclone body. This has a strong detrimental effect on the swirl flow pattern, as the flow direction in this region will be dominated by axial velocity pattern, and not swirling flow pattern, and will therefore decrease the efficiency of the separation process. The swirl flow pattern is the representative of the velocity field driving the separation process. The device according to the invention does not accept any gap between the blades of the swirl element blades and the cyclone body.

It is not possible to see from fig. 2 of D2 that the swirl element is situated in an transitional element where the cross-sectional area of the downstream pipe is smaller than the cross-sectional area of the inlet pipe. On the contrary, according to claim 1 of D2 states: "...a tubular chamber for the separation of the phases of said mixture; a vortex generator device located in correspondence with the inlet of said separation chamber....". From the fig. 2 it is evident that the separation chamber is tapered, not the inlet of the cyclone.

The set of claims has been amended in order to overcome prior art in that the feature from the filed claim 2 has been included in the preamble of claim 1. The characteristic part of the claim includes the feature that no gap exists between the rotational element and the transitional part. An antecedent basis for this feature is shown in fig. 1 of the application as the rotational element is connected only to the transitional part.

The remaining claims are renumbered consecutively, and claim 3 (previous claim 4) is defined more precisely in that the cross-sectional area of the rotational element (10) in the flow direction now is less than 20 % of the flow area of the inlet pipe (2) as stated on p3, l 17-18 in the description.

In our view the amended set of claims reflect the prior art and emphasize the novel features of the invention.

Yours faithfully,
HÅMSØ PATENTBYRÅ ANS


Jostein Soppeland

Enclosure: New claims

C l a i m s

1. A device for an axial cyclone (1) of the kind which is used for separating a fluid from a gas, where the gas during the flow through the axial cyclone (1), primarily
5 in the axial direction of the axial cyclone (1) assigns a rotation around the centre axis (12) of the axial cyclone (1) and where the axial cyclone (1) in the direction of flow comprises an inlet pipe (2), a transitional part (4) with a rotational element (10), and a down-
10 stream pipe (6) where the cross-sectional area of the downstream pipe (6) is smaller than the cross-sectional area of the inlet pipe (2), c h a r a c t e r i z e d in that no gap exists between the rotational element (10) and the transitional part (4).
- 15 2. A device in accordance with claim 1, c h a r a c - t e r i s e d in that the axial vanes (14) of the rotational element (10) project from a substantially common joint (16) primarily radial outward in the direction of the internal surface of the axial cyclone (1).
- 20 3. A device in accordance with one or more of the preceding claims, c h a r a c t e r i z e d in that the cross-sectional area of the rotational element (10) in the flow direction is less than 20 % of the flow area of the inlet pipe (2).